

# Seeds for organic farming



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# Organic seeds



- n Increased demand from customers
- n Stimulation by politicians
  - l NL: in 2010 10% of area organic farming
- n Increased interest by farmers



# Organic seeds



## n Sustainable farming:

- | Bio-dynamic farming
- | Organic farming
- | Integrated farming



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# Organic seeds



## Challenges for organic seed quality

- n GMO 'free' production
- n Production under organic conditions
- n Upgrading of seed quality with applicable methods
- n Adapted to emergence in organic soils
- n Vigorous seeds or other propagation material
- n Healthy start of the crop



# Organic seeds



## EU policy on organic farming

- n Regulation (EEC) Nr. 2092/91 on Organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs
  - | Plant propagation material may not be treated with synthetic chemicals.
  - | Plant propagation material should be produced under organic farming conditions.





# Organic seeds



## Seed purity



- n Weed problems with seed production
  - | Methods for weed removal
  - | Improved sorting techniques
  
- n GMO free seed production
  - | Threshold levels



# Organic seeds

## Seed vigour



### Competition with weeds

- n Weed removal by hand is costly.
- n Labour force is difficult to get

### Use of organic manure

- n Slow mineralisation in the spring



# Organic seeds



## Seed vigour



Can priming aid in competition between crop and weed seedlings?



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# Organic seeds



## Field experiment with primed onion seeds

- n Participation of ten organic farmers
- n Analyses of emergence, root, shoot and plant weight
- n Analysis of final production

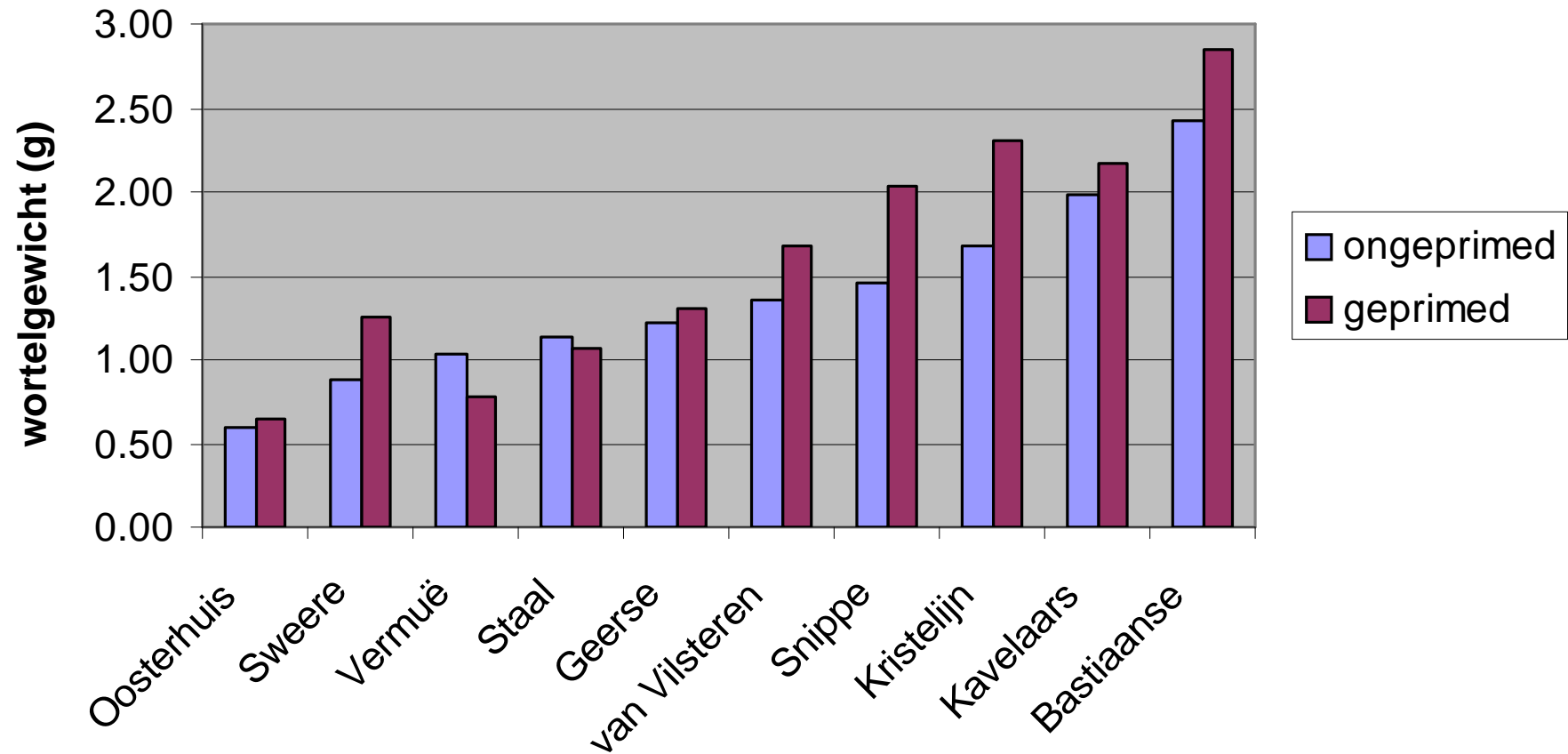


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# Organic seeds



## Root weight

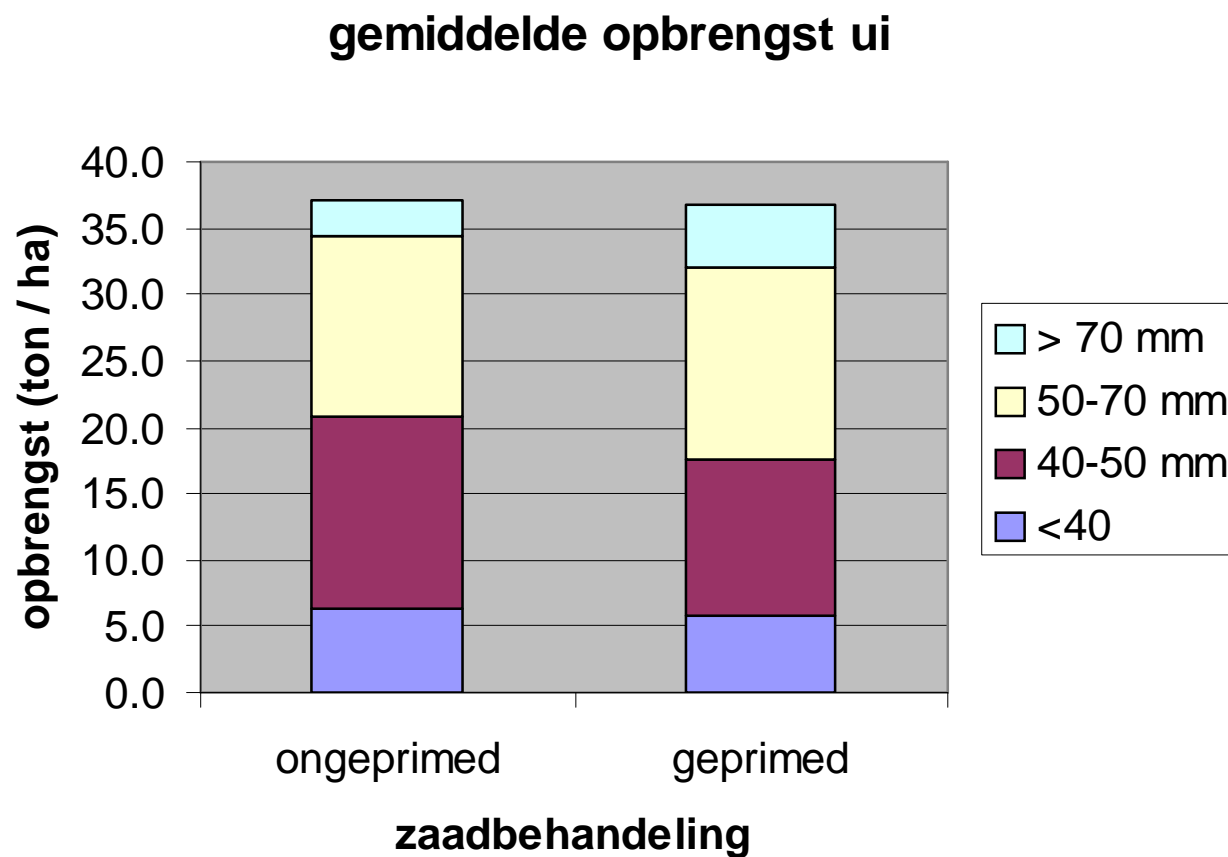


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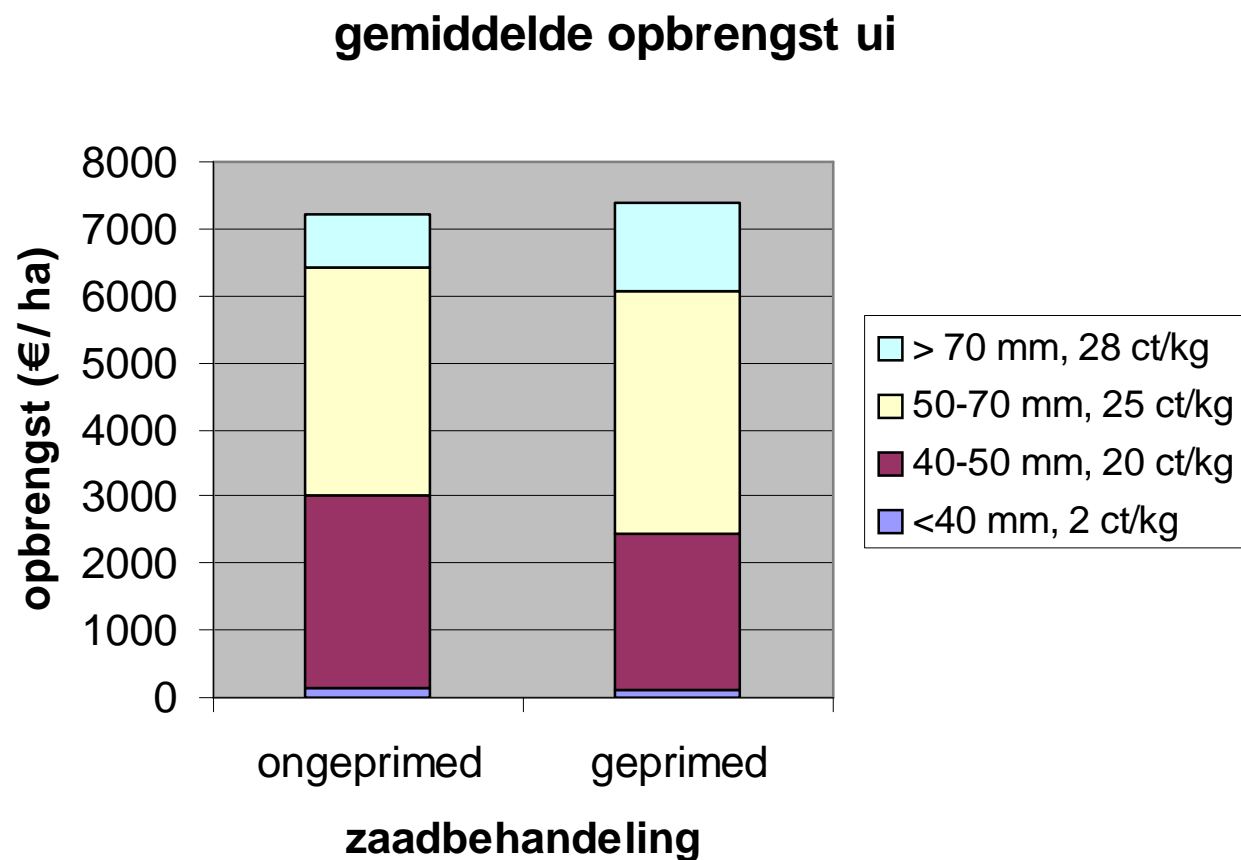
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# Organic seeds



## Onion production

# Organic seeds



## Estimated economic value



# Organic seeds



## Priming effect on organic crop production:

- n Priming accelerates emergence
- n Hardly or no effect on weed competition was observed with onion, carrot and sugar beet
- n Priming resulted in faster early crop growth
- n Priming may provide assurance against early crop decay by pathogens



# Organic seeds



## Seed health



Avoiding crop diseases:

- n Resistance of crop
- n Production of healthy seeds
- n Sorting of seeds
- n Eradication of pathogens

# Organic seeds



## Production of pathogen-free organic seed (1)

### n Prevention

- | hygienic measures
- | date of sowing and harvesting
- | supply of nutrients
- | physical exclusion of pathogens (green houses)
- | application of antagonists during seed production
- | etc.



# Organic seeds



## Production of pathogen-free organic seed (1)



Model:  
carrot - *Alternaria*



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# Organic seeds



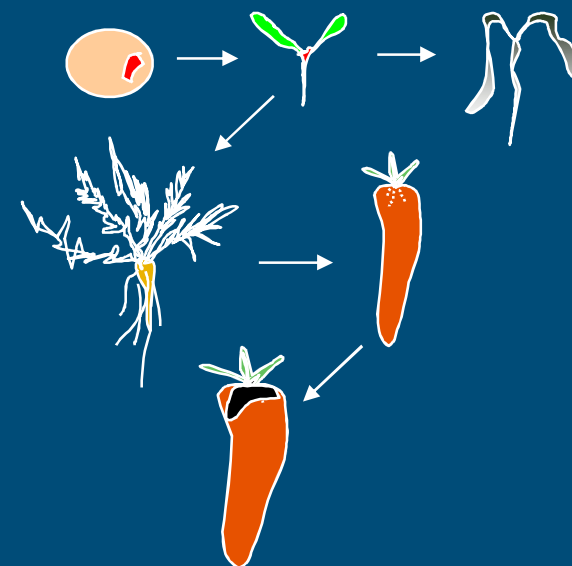
## Transmission of *A. radicina* in the 1<sup>st</sup> part of the chain

“Damping off” relates to heavy seed infections

HWT



N  
T



Latent infections and crown-rot relate to slight seed infection



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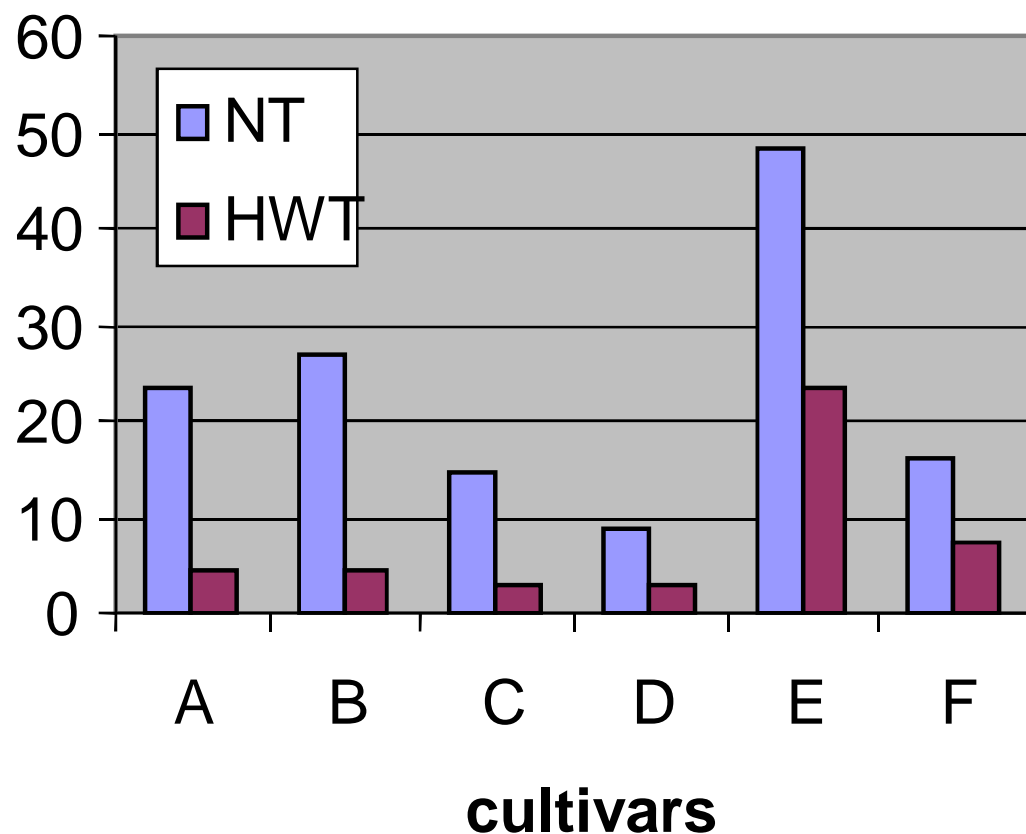


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# Organic seeds



% flowering plants with *A. radicina*



Occurrence of latent *A. radicina* (AR) infections in flowering carrot plants of six varieties grown from contaminated basic seed left untreated (NT) or hot water treated (HWT). Roots stored for 3 months at 5 °C before potting.





# Seed health and need for sanitation

- n Sanitation by seed company is needed
  - | Physical methods (hot water, aerated steam, ...)
  - | Natural antifungal or antibacterial compounds
  - | Antagonistic micro-organisms
  
- n Stimulation endogenous defence
  - | Resistance inducers



# Organic seeds



Hot moist air treatment  
ThermoSeed™



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# Organic seeds



## Production of pathogen-free organic seed (2)

### n Eradication

- | biological treatments  
(micro-organisms, phages, etc.)
- | chemical treatments  
**green chemicals:**
  - (1) active compound is of natural origin and not chemically processed
  - (2) active compound is minimally purified from crude extract
- | **physical treatments**  
(hot water, heat, radiation)





# Sanitation with natural compounds

- n Treatment is always a second choice
- n Compounds should be allowed according to national (EU) regulations
  - | Human and eco-toxicity
- n Compounds should be allowed for organic farming
  - | EU regulation 2092/91
- n Not phytotoxic
- n Treatment costs should be low



# Organic seeds



## Treatments with green chemicals

Groups of green chemicals:

- n plant- (and animal extracts): onion extract, chitosan
- n essential oils: neem tree oil, thyme oil
- n anti-microbial proteins: nisin, lactoferrin
- n other natural antibiotics: chelators, detergents, elicitors



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# Organic seeds



## Choice for essential oils (1)

- n Many examples of activity against pathogenic fungi and bacteria
- n Easily degradable by plants and micro-organisms (low persistence)
- n Relatively cheap



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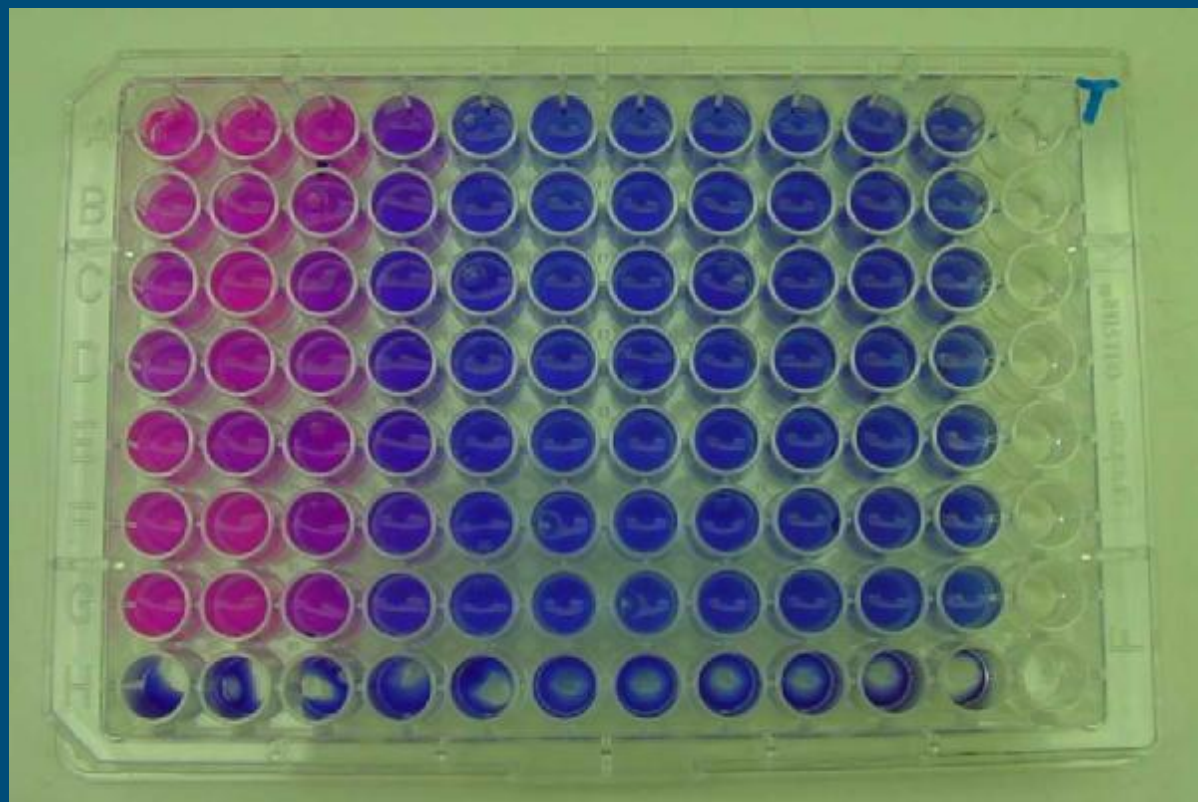


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# Organic seeds



## Essential oils effects on bacteria



Essential oils effects on bacteria: Microplate assay with resazurin, pink = actively growing bacteria



# Sanitation with natural compounds

Only effective components allowed:

- n Essential oils  
thyme, oregano, clove, ...

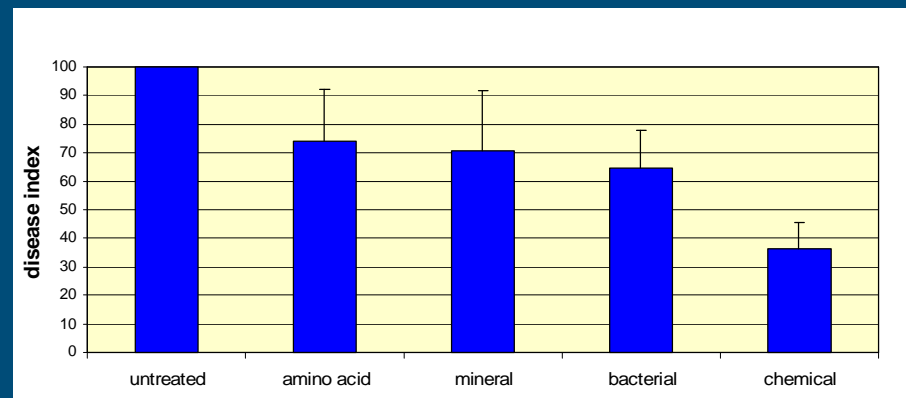
Effective but not allowed:

- n Organic acids  
Acetic acid (vinegar), lactic acid, ascorbic acid, ...  
Restricted by EU regulation 2092/91

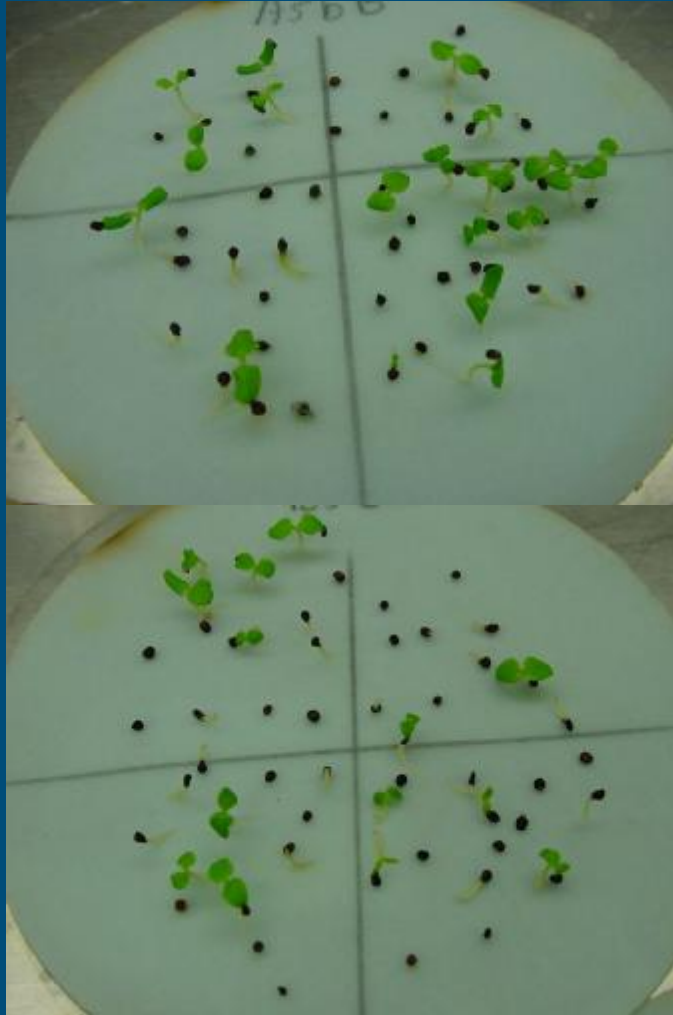


# Enhancing natural defence of the plants

- n Plants have natural defences against pathogens
- n This defence can be stimulated by natural agents
  - l Chitosan, amino acids, minerals, dead pathogens
- n How do plants react?
- n How to optimize the defence?
- n Application as seed treatment?



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- n Balance between seed and pathogen for sensitivity towards physical treatments



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# Organic seeds



- n What determines seed sensitivity to physical treatments?
  - | Crop
  - | Variety
  - | Seed moisture content
  - | Seed maturity?
  - | Seed 'priming'?



# Organic seeds



## Production of pathogen-free organic seed (3)

### Physical seed treatments

#### n Different treatments:

- | Hot water
- | Hot humid air
- | Electron seed treatment
- | .....

#### n Main issue: differential sensitivity of the pathogen and the seed

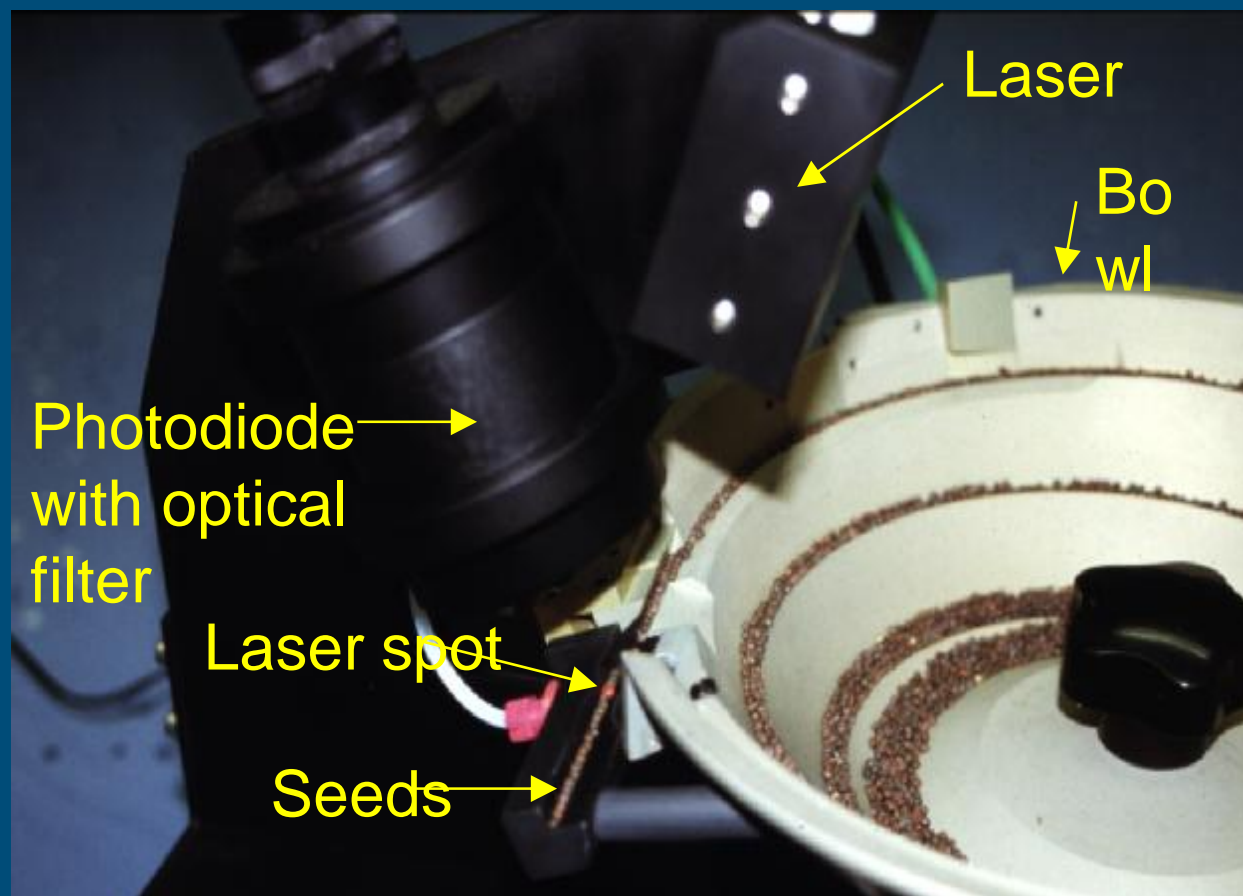




# Organic seeds



Is seed maturity important?

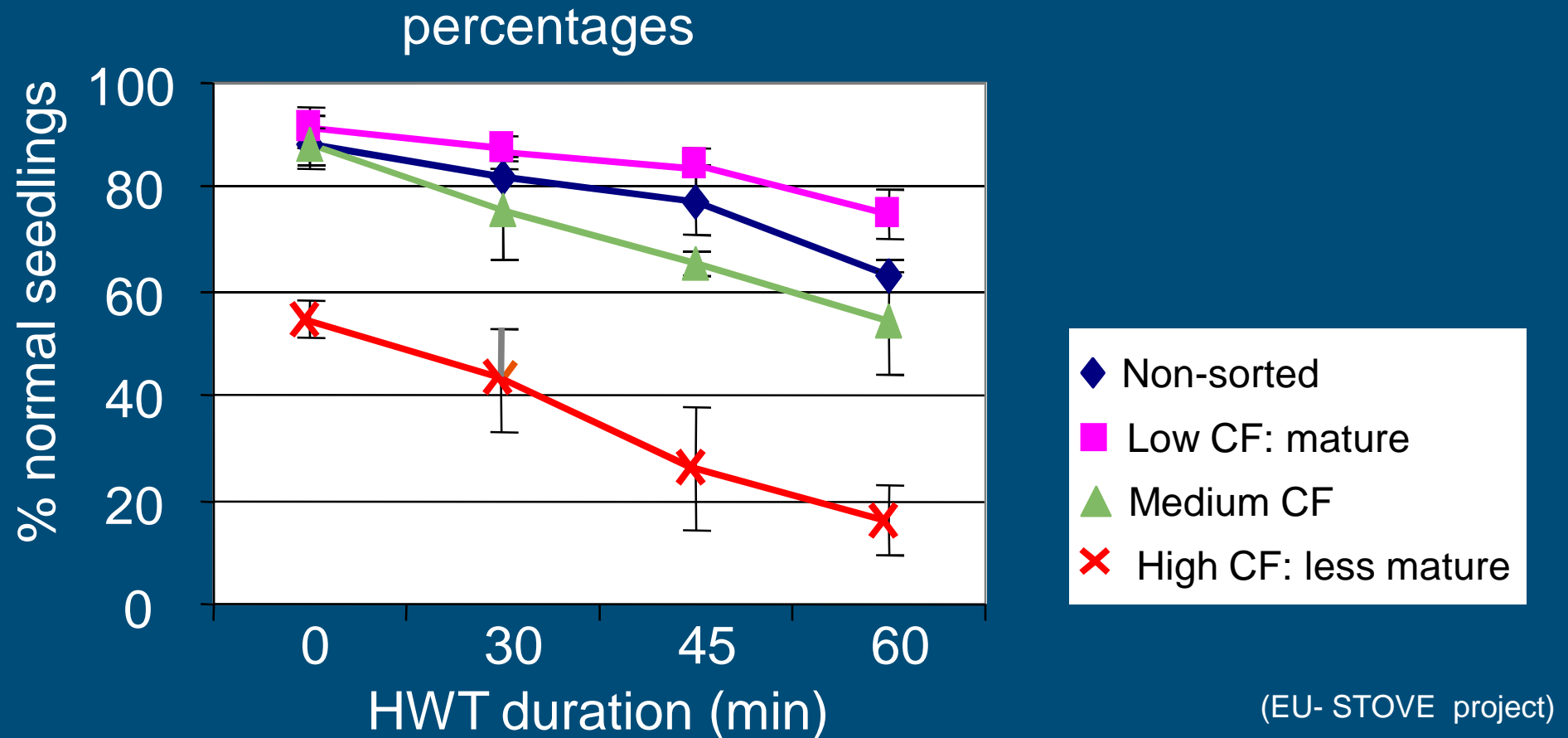


Lab chlorophyll analyzer and sorter

# Organic farming



## Sensitivity of cabbage seeds to hot water treatments



# Production of pathogen-free organic seed



- n Detection of pathogens
- n Analyses of pathogen vitality

Flow cytometry offers a method for simultaneous quantification and vitality analysis



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# Organic farming



## Seed vigour

- n Seeds may start germination processes prior to harvest
- n Are these seeds more sensitive to physical treatments?



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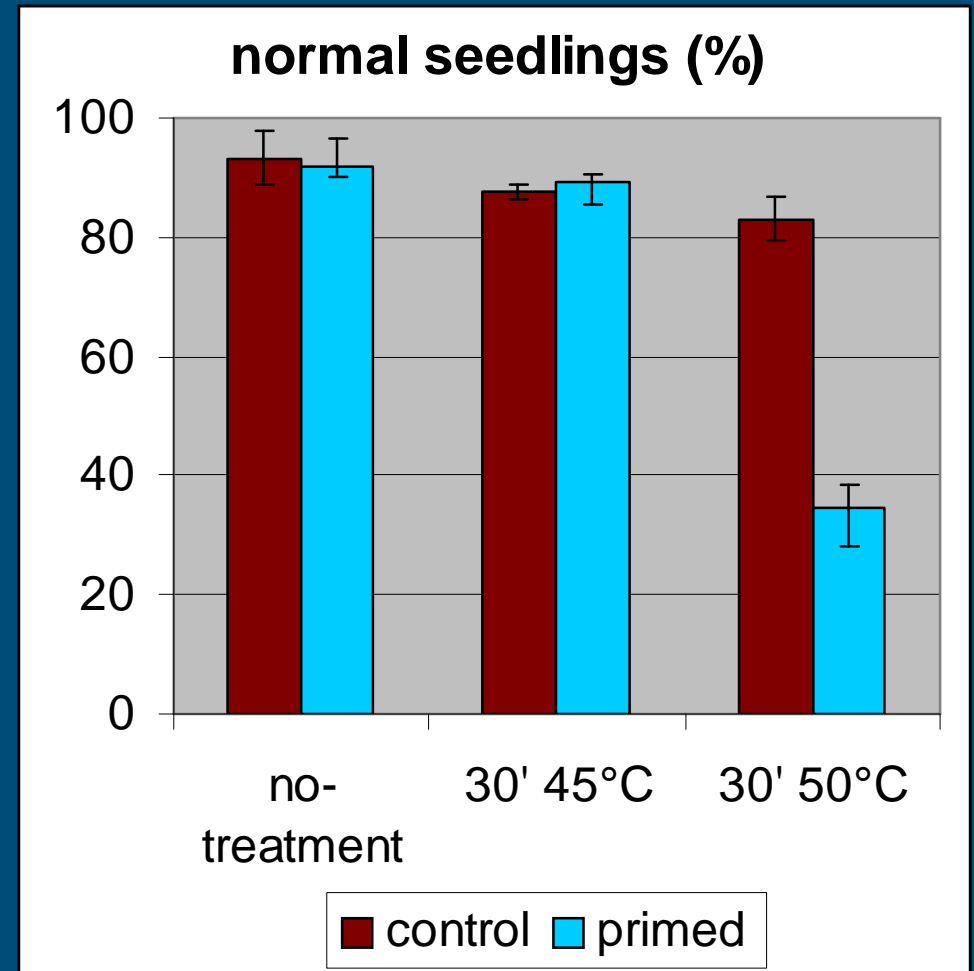


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# Organic farming



- n Pre-germinated seeds are more sensitive to hot water treatments
- n Pre-germination is not always visible by eye, markers are needed





# Seeds for organic farming

Seed scientist can contribute considerable to improve quality and availability of organic seeds



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